BY ORDER OF THE
SECRETARY OF THE AIR FORCE

AIR FORCE INSTRUCTION 41-203

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Health Services

ELECTRICAL SAFETY IN MEDICAL TREATMENT FACILITIES

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This AFI implements AFPD 41-2, *Medical Support*, and provides guidance for electrical safety in the medical treatment environment. It also serves as a central reference for the use of nationally recognized safety standards. This guidance is not intended to be all inclusive, but establishes minimum requirements for electrical safety. It emphasizes existing standards with references provided.

SUMMARY OF CHANGES

This instruction replaces AFR 160-3, *Electrical Safety in Medical Treatment Facilities*. It recognizes the National Fire Protection Association (NFPA) as the definitive guidance and has eliminated annual inspection of non-medical equipment used outside patient care area. It eliminates references to Navy procedures and requirements. It changes requirements for chassis and lead leakage current checks.

Section A—Defining the Electrical Safety Program

1. Program Purpose: The Medical Treatment Facility (MTF) is a unique environment and requires special procedures to ensure the electrical safety of patients and staff. Each facility will establish a proactive electrical safety program that centers around identifying a potential hazard, correcting the hazard, testing to ensure the hazard does not recur, and training personnel to identify new and existing hazards.

2. Philosophy: Unless specifically addressed in this instruction, AFI 41-201, *Clinical Engineering Services*, or AFOSH 127-8, *Medical Facilities*, the MTF electrical safety program adheres to the guidance and standards established by NFPA 99, *Health Care Facilities;* NFPA 101, *Life Safety Code;* and NFPA 70, *National Electric Code*.

3. Responsibilities:

3.1. Hospital Commander and Administrator.

- Ensure both implementation of the electrical safety program and close coordination between functional areas.
- Identify and document designation of general care, critical care, and wet area locations within the MTF.
- Ensure adequacy of the Electrical Safety Program and its inclusion in the local training programs.
- Review actions of the Safety Committee.
- Approve local electrical safety procedures established to satisfy special or unique safety requirements.
- Approve policy and procedures for the use of privately owned, line-operated electrical devices.

3.2. Facility Management.

- Maintains the overall safe environment of the entire MTF.
- Ensures the identification and correction of electrical safety hazards.
- Coordinates with BCE to ensure inspections of the power distribution and emergency power systems are performed and documented.
- Coordinates with BCE for the correction of power distribution system hazards identified through inspection.

3.3. Medical Equipment Maintenance.

- Maintains all medical equipment.
- Maintains oversight responsibility for the safe use of electrical devices in patient care areas.
- Performs required electrical safety inspections of all medical and nonmedical equipment used in patient care areas as outlined in this AFI and AFI 41-201.
- Performs required testing of conductive flooring, isolated power systems, and ground fault circuit interrupters (GFCIs).
- Assists the Chief of the Medical Staff and others responsible for in-service training by providing user education on electrical safety.
- Maintains documentation of medical equipment safety testing and a file of service and operating literature as outlined in AFI 41-201. Documentation can be maintained in electronic file formats.

3.4. Medical Material and Medical Equipment Management Offices.

- Coordinate with Medical Equipment Maintenance and Facilities Management to ensure the acquisition of equipment and supplies which satisfy the electrical safety standards outlined in this AFI.
- Ensure equipment proposed for purchase is compatible with existing equipment and utility systems.
- Ensure contracts reflect the requirements of AFI 41-201, NFPA 99 Chapter 7-6.2.1.7 "Specifications of Conditions of Purchase," and 7-6.2.1.8 "Manuals for Appliances".

3.5. MTF Safety Committee.

- Reviews and oversees MTF safety programs.
- Reviews actions taken by BCE, MTF Safety Officer, Medical Equipment Maintenance, and Facility Management regarding the inspection, testing, and documentation of MTF electrical equipment, power systems, and ground distribution systems.
- Reviews and recommends to the MTF Commander or Administrator local electrical safety actions and procedures.

3.6. Chief of Medical Staff, In-service Education Coordinators, and Department Chiefs.

- Provide training on electrical safety and the safe operation of medical equipment.
- Ensure adequate awareness of the need for electrical safety and electrical safety briefings are conducted.
- Ensure electrical safety training is documented on AF Form 55, **Employee Safety and Health Record,** and when appropriate, on AF Form 1098, **Special Task Certification and Recurring Training**.

3.7. Safety Officer.

- Performs duties outlined in AFI 91-202, *The USAF Mishap Prevention Program.*

3.8. Base Civil Engineering (BCE).

- Provides engineering support for the installation, maintenance, and testing of MTF power distribution systems.
- Conducts inspections and evaluations of the electrical distribution system required by NFPA 99 and this AFI.
- Performs required testing of the grounding system integrity and electrical receptacles required by NFPA 99 and this AFI.
- Provides written analysis, including actions both required and taken, of electrical distribution system inspections and evaluations.

3.9. Medical Equipment Repair Centers (MERC).

- Supplement support provided by local Medical Equipment Maintenance.
- Provide technical guidance and assistance with complex electrical safety problems at supported bases.
- Review, evaluate, and document electrical safety programs at supported bases.
- Provide electrical safety inspections of patient care equipment for directly supported MTFs.

3.10. Equipment Users and Staff.

- Implement the electrical safety program.
- Observe safe practices using of electrically operated equipment, particularly in the presence of patients subject to invasive procedures.
- Ensure equipment is visually inspected for electrical hazards and known problems are corrected before equipment is placed in use.
- Ensure identified hazards are reported.
- Report all incidents of equipment-related accidents using locally established procedures.

Section B—Program Operation

4. Training the Staff:

4.1. The fundamental element of the hospital electrical safety program is safe equipment operation. Only when the entire hospital staff becomes consciously aware and alert to practices which constitute "good electrical hygiene" will the hazards of electrical shock be acceptably minimized. Joint Commission on Accreditation of Healthcare Organizations (JCAHO) standards requires safety training as part of staff orientation and refresher training to ensure safe use of equipment.

4.2. Training is the responsibility of the area supervisors.

4.3. Training programs incorporate the following:

- Orientations. Include procedures for reporting safety hazards, points of contact for corrections, accident reporting and investigation procedures, hazards that are unique to their work area, and equipment in-servicing.
- Equipment in-service. Include safe operation and user maintenance. Each staff member must understand how to visually inspect equipment for potential hazards. Manage training so that it recurs at an appropriate interval, based on the type of equipment.
- Electrical safety briefings. Include, as a minimum, program changes, the results of safety committee's findings from the organizations safety program, and periodic training in fire suppression. Additional guidance is found in NFPA 99 Chapter 7-6.5 "Qualification and Training of Personnel".

4.4. Biomedical Equipment Technicians (BMETs), or clinical engineers when assigned, can assist in electrical safety training programs. MTFs may also consult Medical Equipment Repair Centers for additional guidance in developing safety training programs.

4.5. Additional training material can be found in NFPA 99 Appendix A-3-2.2.2 "Shock Prevention" or through agencies listed in attachment 1.

5. Extension Cords and Adapters:

5.1. Restrict use of extension cords to the temporary installation of equipment. When an extension cord is used to place equipment into operation for extended operation, initiate a work order to have an electrical outlet installed.

5.2. Extension cords must be suitable for use (#16 AWG or heavier) and conform to manufacturer requirements for power cords and attachment plugs as defined in NFPA 99 Chapter 9-2.1.2.

5.3. Ungrounded Extension Cords and Three-to-Two-Prong Adapters are prohibited per NFPA 99 Chapter 7-6.2.1.5 "Adapters and Extension Cords". However, BMETs may use the three-to-two-prong adapters ("cheater adapter") when necessary to facilitate testing and repair of medical equipment.

6. Use of Privately Owned Equipment:

6.1. Patient Owned.

6.1.1. Restrict use of patient owned electrical devices to those necessary for the welfare of the patient and appropriate for the patient care environment.

6.1.2. Develop local written procedures to control the use of patient-owned electrical devices in patient care environments. These procedures ensure:

- Visual safety inspection of the device by trained personnel.
- Inspection and approval of the device is documented. ***NOTE:*** Personnel performing inspections are trained by medical equipment maintenance personnel on local safety inspection procedures.

6.2. Staff-owned.

6.2.1. Staff-owned medical devices must conform to the same requirements of hospital-owned medical equipment. See AFI 41-201.

6.2.2. Staff-owned nonmedical electrical devices are limited to use in non-patient care areas when possible. They are subject to the same safety and fire hazards as hospital-owned devices, and should be inspected and used with discretion.

6.2.3. Staff members are responsible for electrical devices not owned by the hospital and ensure the devices are:

- Maintained in a safe operation condition.
- Compliant with local ground safety and fire regulations.
- Inspected annually by an appropriately trained individual.

6.2.4. Staff members file, and retain at the MTF, equipment inspection and maintenance documentation.

6.3. Consult medical equipment maintenance personnel when the safety of a device is questionable.

Section C—Program Requirements

7. Administrative Tasks:

7.1. Classification of Areas.

- Classify all patient care areas of a hospital as either general care or critical care.
- Classify wet locations within the general care and critical care areas.
- Designate anesthetizing locations.
- The MTF Commander or administrator approves the designation of these areas in writing and provides this information to functional areas involved with maintaining electrical safety.
- Definitions for classification can be found in attachment 1 or NFPA 99 Chapter 2.
- Source of requirement: NFPA 99 Chapter 12-2 "General Responsibilities."

7.2. Documentation.

- Maintain records of tests, test results, and associated repairs and modifications for all normal electrical distribution systems.
- Maintain written record of inspections, performance tests, exercising periods and repairs of all essential power distribution systems.
- Where installed, maintain records of isolated power systems and keep a permanent record of the results of each test.

- Source of requirement: NFPA 99 Chapter 3-6.2.5 "Recordkeeping".

7.3. Literature File.

- Maintain an accessible permanent file of operating instructions and maintenance manuals.
- Source of requirement: NFPA 99 Chapter 7-6.3.1.1 "Instruction Manuals".

8. Electrical Systems Testing:

8.1. Testing the Grounding Systems in Patient Care Areas.

- Test the effectiveness of the grounding system for new construction, and after any alteration or replacement of an existing system.
- Responsibility of BCE, reference AFI 35-1065, *Grounding Systems*.
- Source of requirement: NFPA 99 Chapter 3-5.2.1 "Grounding Systems in Patient Care Areas".

8.2. Testing the Receptacles in Patient Care Areas.

- Test the receptacles in patient care areas for physical integrity, continuity, polarity, and retention force on a regular interval as defined by NFPA 99. (***NOTE:*** The 1993 Edition of NFPA 99 sets the interval at not more than 12 months for general care and wet locations and not more than 6 months for critical care areas.)
- Responsibility of BCE.
- Source of requirement: NFPA 99 Chapter 3-5.2.2 "Receptacles in Patient Care Areas" and 3-6.2.3.1 "Testing Interval for Receptacles in Patient Care Areas".
- Additional Information: Reference AFI 35-1065. ***NOTE:*** NEC Article 517 Specifies that all patient care areas will have hospital grade outlets.

8.3. Testing the Ground Fault Circuit Interrupters (GFCIs) in patient care areas.

- Test GFCI's by momentarily connecting a device or component to flow 6 ma of current between ground and the energized conductor of power distribution circuit. Verify that the GFCI does interrupt the power.
- Test functioning of GFCIs in patient care areas on a regular interval as defined in NFPA 99. (***NOTE:*** The 1993 edition of NFPA 99 sets the interval at not more than 12 months.)
- Responsibility of Medical Equipment Maintenance or BCE.
- Source of requirement: NFPA 99 Chapter 3-5.2.3 "Ground Fault Circuit Interrupters in Patient Care Areas" and 3-6.2.3.3 "Testing Interval for GFCIs in Patient Care Areas."
- Additional Information: See AFI 41-201. When possible establish an agreement to have BCE perform this operation during the test of the receptacles.

8.4. Testing the isolated power systems and line isolation monitors (LIM).

- Test the functioning of each LIM circuit on a regular interval as defined in NFPA 99. Actuate the LIM test switch or ground each circuit through a resistive load as indicated by the interval. (***NOTE:*** The 1993 edition of NFPA 99 requires that the LIM test switch be activated on a monthly basis and the circuit be tested through a resistive load every 6 months.)

- Test the functioning of each LIM circuit by actuating the LIM test switch and by grounding each circuit through a resistive load after installation, repair, or renovation.
- Responsibility of Medical Equipment Maintenance. See AFI 41-201.
- Source of requirement: NFPA 99 Chapter 3-5.2.4 "Isolated Power Systems."

8.5. Testing of Alternate Power Sources and Transfer Switches.

- Test alternate power sources, as defined by NFPA, under load and from cold start. (***NOTE:*** The 1993 edition of NFPA 99 requires testing of units for 30 minutes at intervals of not more than 30 days.)
- Responsibility of facilities management and BCE.
- Source of requirement: NFPA 99 Chapter 3-5.1.2 "Source (Up to and including Transfer Switch)" and 3-6.2.4. "Maintenance and Testing of Essential Electrical System".
- Additional Information: NFPA 99 includes a requirement to test the transfer switches, generator sets, circuit breakers and storage batteries.

9. Equipment Testing:

9.1. Chapters 7 and 9 of the NFPA 99 contain information and procedures for testing medical equipment. The testing intervals for all Air Force medical equipment is provided in AFI 41-201. Use the NFPA recommended interval only if there is no comparable equipment listed.

9.2. Test battery operated devices, that are usable when connected to line power, using the same requirements of line-operated devices.

9.3. Electrical Safety Inspections of Equipment Used in Patient Care Areas.

- Safety inspections include visual inspection of the unit, physical integrity of power cords and strain reliefs, and other appropriate tests defined in this AFI.
- Establish local guidance, when appropriate, for the testing of ground pin to chassis resistance on portable equipment with detachable power cords.
- Responsibility of Medical Equipment Maintenance.
- Source of requirement: AFI 41-201 and NFPA 99 Chapter 7-6.2.1.2 "Testing Intervals" and 7-5.1.3 "Testing Requirements".

Resistance and Leakage Current Tests.

- Perform resistance and chassis leakage current tests when the equipment is undergoing an intial inspection, has been repaired or modified, or is used in critical care areas as defined in this AFI. See NFPA Chapter 7-6.2.1.2, Number 3.
- Equipment that is subject to deterioration of the system's electrical characteristics may be identified by AFMLO or local Medical Equipment Maintenance as requiring resistance and leakage current tests during safety inspections.
- Responsibility of Medical Equipment Maintenance.

- Source of requirement: AFI 41-201 and NFPA 99 Chapter 7-6.2.1.2 "Testing Intervals" and Chapter 7-5.1.3 "Testing Requirements."

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Attachment 1

GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS

References

AFPD 41-2, *Medical Support*

AFI 41-201, *Clinical Engineering Services*

AFI 91-202, *The USAF Mishap Prevention Program*

AFI 35-1065, *Grounding Systems*

AFOSH 127-8, *Medical Facilities*

NFPA 99, *Health Care Facilities*

NFPA 101, *Life Safety Code*

NFPA 70, *National Electric Code*

NFPA 70 (NEC) Article 517 "Health Care Facilities"

Abbreviations and Acronyms

AFI—Air Force Instruction

AFMLL—Air Force Medical Logistics Letter

AFMLO—Air Force Medical Logistics Office

AFOSH—Air Force Occupational Safety and Health

AFPD—Air Force Policy Directive

AWG—American Wire Gauge

BCE—Base Civil Engineering

BMET—Biomedical Equipment Technician

GFCI—Groundfault Circuit Interrupter

JCAHO—Joint Commission on Accreditation of Healthcare Organizations

LIM—Line Isolation Monitor

MERC—Medical Equipment Repair Center

MTF—Medical Treatment Facility

NEC—National Electric Code (NFPA 70)

NFPA—National Fire Protection Association

Terms

Patient Care Area—Any portion of a health care facility where patients are examined or treated. (Note: Business offices, corridors, lounges, day rooms, dining rooms, or similar areas are not classified as patient care areas.)

General Care Areas—Patient bedrooms, examining rooms, treatment rooms, clinics, and similar areas in which the patient is in contact with ordinary appliances such as nurse-call systems, electric beds, examining lamps, telephones, and entertainment devices. (Note: In such areas, patients may be connected to electromedical devices such as heating pads, electrocardiographs, drainage pumps, monitors, otoscopes, ophthalmoscopes, intravenous lines, etc.).

Critical Care Areas—Special care units, intensive care units, coronary care units, angiography laboratories, cardiac catheterization laboratories, delivery rooms, operating rooms, and similar areas in which patients are subject to invasive procedures and connected to line-operated, electromedical devices.

Wet Locations—A patient care area that is "normally" subject to wet conditions while patients are present. This includes standing fluids on the floor or drenching of the work area, either of which condition is intimate to the patient or staff. Routine housekeeping procedures and incidental spillage of liquids do not define a wet location.

Additional definitions and terms can be found in NFPA 99 Chapter 2.

Additional Sources of Information

Commercial publications can be obtained from the following sources.

- National Fire Protection Association (NFPA) codes and pamphlets: NFPA, Publications Service Department, Batterymarch Park, Quincy MA 02269-9990, (800) 344-3555.
- Joint Commission Manuals: Joint Commission on Accreditation of Healthcare Organizations, One Renaissance Boulevard, Oakbroook IL 60181, (708) 916-5600.
- ECRI documentation: ECRI, 5200 Butler Pike, Plymouth Meeting PA, 19462, (215) 825-6000.